Increasing Flow Velocity

- Velocities can either be increased by increasing flows (flow augmentation) or by decreasing the cross-sectional area of the run-of-river projects (operate at lower elevations*)
- Velocity in the river varies with location (e.g. thalweg, mid-reservoir, tailwater, etc.)
- Velocity in the river varies with runoff. For instance, estimated water particle travel time for the Snake River from the Clearwater River to the confluence of the Columbia River is 10.7 days at 80 kcfs and 42.3 days at 20 kcfs.
- There are multiple methods of estimating velocity (water particle travel time), for example, HEC2 and Q=VA.

To demonstrate, assuming that a ten percent increase in flow rate is roughly equivalent to a ten percent increase in flow velocity, the following are volumes of water required to increase summer flows ten percent in low, medium and high flow conditions. The water travel time methodology used as the basis for the assumption in this example is the Reservoir Replacement Method. The Reservoir Replacement Method calculates the time required to empty the reservoir at a given outflow rate.

July-August Average Flows:

	Base Case	plus 10%	Additional Volume Required
	Columbia River at McNary		
Low Flow	150 kcfs	165 kcfs	1.8 MAF
Med. Flow	180 kcfs	198 kcfs	2.2 MAF
High Flow	225 kcfs	248 kcfs	2.8 MAF
	Snake River at Lower Granite		
Low Flow	30 kcfs	33 kcfs	0.4 MAF
Med. Flow	38 kcfs	42 kcfs	0.5 MAF
High Flow	48 kcfs	53 kcfs	0.6 MAF

Note: for comparison purposes, Dworshak (the largest federal reservoir in the Snake River Basin has 2 MAF of storage) currently drafts 80 feet (equivalent to 1.2 MAF draft) in the summer for flow augmentation, and Grand Coulee (the largest federal reservoir in the Columbia River Basin has 5 MAF of storage) currently provides up to 1 MAF draft to augment summer flows.

* Note: Minimum Operating Pool paper discusses factors to be considered in operating mainstem projects at or below MOP.